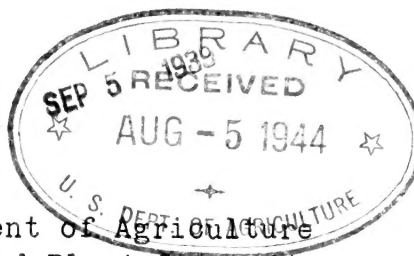


Historic, Archive Document

Do not assume content reflects current scientific knowledge, policies, or practices.



August 1939

United States Department of Agriculture
Bureau of Entomology and Plant Quarantine

A DUST DELIVERY TUBE FOR LABORATORY EXPERIMENTS WITH CONTACT INSECTICIDES

By Robert A. Fisher,¹
Division of Truck Crop and Garden Insect Investigations

Laboratory tests with contact dusts for the pea weevil (Bruchus pisorum (L.)), conducted in connection with field-control experiments, have resulted in the development of a dust-delivery tube which gave more uniform distribution of dust, and higher kills with smaller quantities of dust, than other types tested.

The apparatus used for this work consists essentially of a bell jar having a diameter of $9\frac{1}{2}$ inches, a small wooden stand 11 inches square with a 1-inch hole bored through the center of its top, and a glass delivery tube for discharging dust into the jar (fig. 1). The delivery tube is connected to a pressure gauge on a compressed-air line by a 3-foot piece of rubber tubing.

The delivery tube originally used had an inside diameter of 7.3 millimeters, with the opening slightly flared. Spirally arranged indentations along the length of the tube helped to break up dust particles and distribute them more evenly. However, the distribution over the area beneath the bell jar was not as even as was desirable, apparently because it was impossible to set the tube exactly perpendicular for each test.

After some experimentation it was found that dust which was discharged through a tube that had been drawn to a fine tip settled in a more uniform film within the jar. This tube was made from 7-millimeter glass tubing, with the inside diameter of the opening about 1.5 millimeters. Care was taken, when drawing out the tip, to center the opening as nearly as possible. The tube was bent at right angles, the perpendicular part bearing the constricted tip being $3\frac{1}{2}$ inches long.

¹ Formerly junior entomologist, Division of Truck Crop and Garden Insect Investigations, Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture. At present assistant entomologist, Department of Entomology, University of Idaho.

The dust reservoir, adopted from the apparatus described by Payne and Stultz,² consisted of a centrifuge tube fitted with a two-hole rubber stopper. Two glass tubes were fitted into the stopper. One tube, extending nearly to the bottom of the centrifuge tube, was connected to the air line. The second, which was flush with the lower surface of the stopper, was connected to the delivery tube by a short piece of rubber tubing. This apparatus, with the delivery tube, is shown in figure 2.

When a test is to be made a charge of dust is placed in the dust reservoir, and the delivery tube is inserted through the hole in the stand, where it is held in place by a rubber stopper. Fifty weevils, confined in a small screen cage inverted over a petri dish, are placed on the stand, together with two pieces of weighed millimeter paper, each measuring 70 by 90 millimeters. The weevils and papers are then covered by the bell jar. With all the materials thus in place the dust is blown into the jar under a pressure of 5 pounds per square inch, and allowed to settle on the insects. Five minutes time is sufficient for practically all the dust to settle. The weevils are then transferred to a clean cage and placed in a constant-temperature box for further observation to determine the mortality. The quantity of dust per unit area settling on the insects is readily determined by reweighing the millimeter paper. In this manner quantitative determination of the toxicity of various dust mixtures can be made.

The constricted tube not only gives a more uniform distribution of dust, but the mortality resulting from the same quantity of dust is greatly increased. A cube dust in talc, containing 1.00 percent of rotenone, gave a median lethal dose of about 10 milligrams per 100 square centimeters when the original open tube was used; with the constricted tube the median lethal dose was about 5 milligrams per 100 square centimeters. Similar results were obtained when diatomaceous earth was used as the diluent. The main reason for this increased mortality apparently lies in the mechanical distribution of the dust particles. Dust particles discharged from the original tube have some tendency to cling together. With the constricted tube the particles are nearly all separated from each other, and so possibly have more opportunity to come into direct contact with the insect body. This difference in dust distribution is shown in figures 3 and 4.

It has been demonstrated that the size of the opening of the tube through which dust is discharged into the bell jar plays an important part in the type of dust film deposited. This was done by employing the constricted tube, a glass tube of the same diameter as the constricted tube but without the constricted tip, and the original open tube, all in conjunction with the centrifuge tube dust reservoir. Microscopic examination of the dust films showed that the larger the opening the coarser was the film deposited.

² Payne, S. H., and H. T. Stultz. 1937. A laboratory apparatus for determining the relative toxicity of contact dusts. Sixty-seventh Annual Report of the Entomological Society of Ontario, 1936, pp. 30-33, illus.

Another factor which has some effect on the type of dust film deposited is electrostatic charges on the dust particles. Dust blown from the original open tube carries little, if any, electrostatic charge. However, during agitation of the dust in the centrifuge tube the particles become negatively charged.³ Since all the particles carry like charges they tend to repel each other and settle in a fine film. This is shown by the fact that dust films from the open tube used alone are slightly coarser than films deposited when the open tube is used with the centrifuge tube dust reservoir.⁴ From this it appears that both the size of opening of the delivery tube and the charge received in the dust reservoir have an important bearing on the efficiency of contact dusts for the pea weevil.

³ Determined by Dr. G. W. Hammar, Department of Physics, University of Idaho, Moscow, Idaho.

⁴ Charged dust particles also adhere better to any surface than uncharged particles, and so undoubtedly stick better to the insects' bodies.

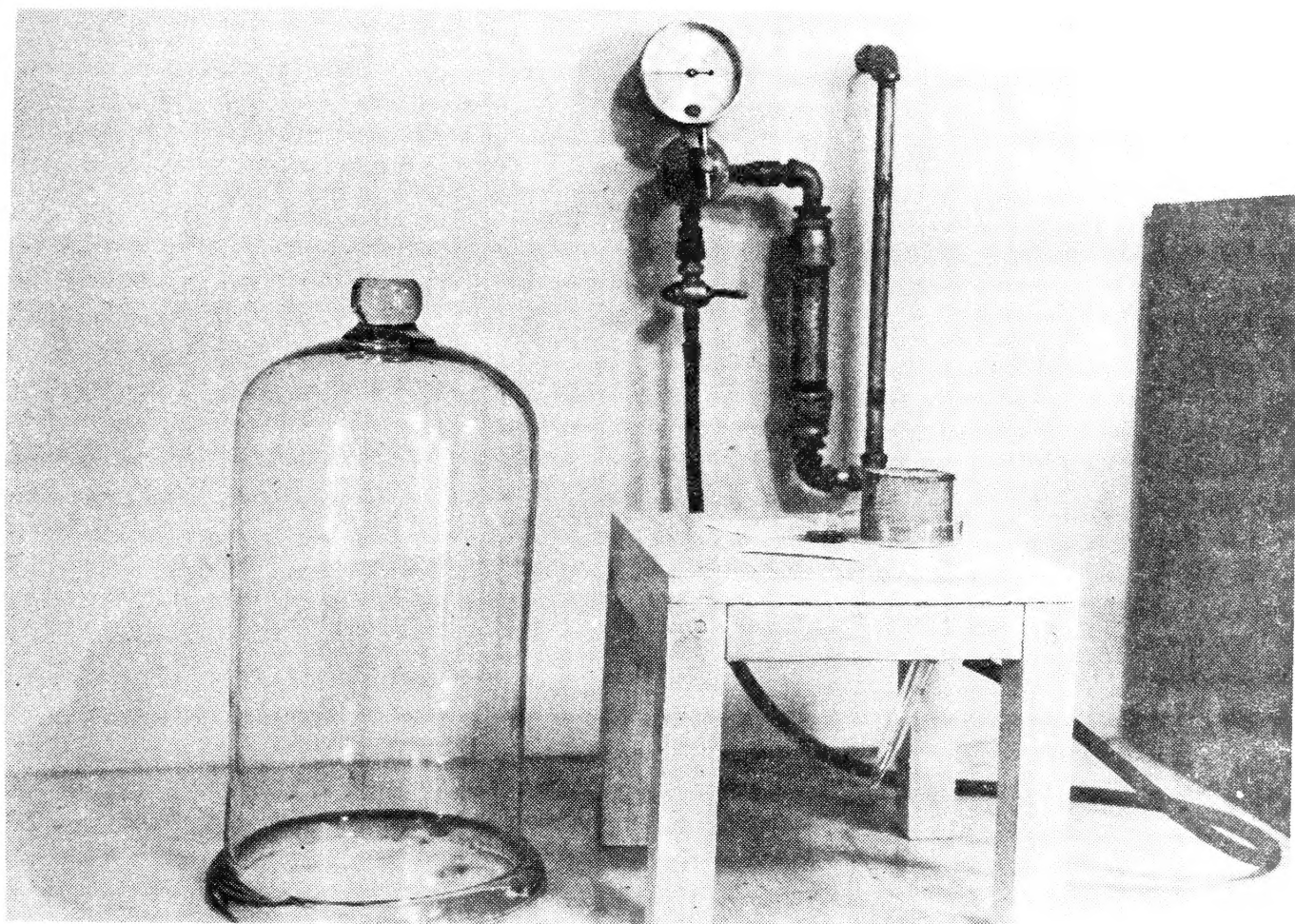


Figure 1. — Apparatus used in laboratory dusting experiments.

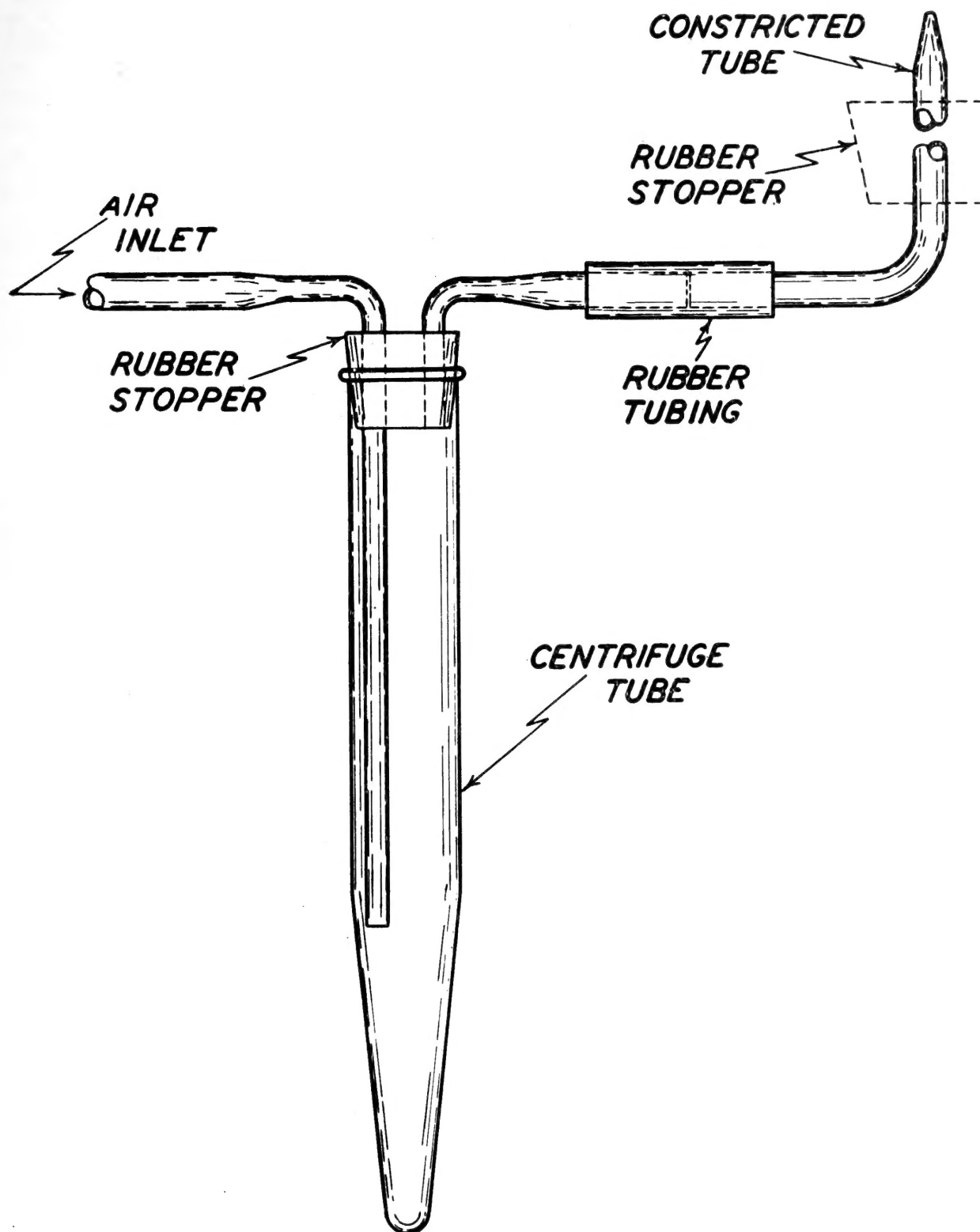


Figure 2. —Details of delivery tube and dust reservoir used in laboratory experiments.

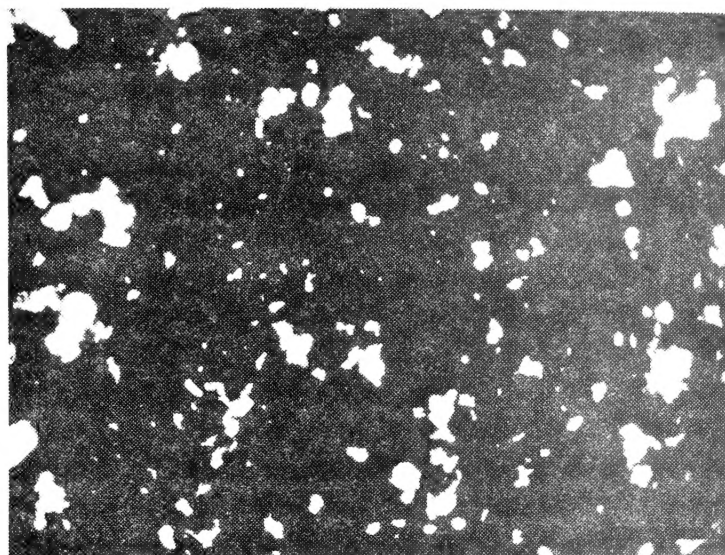


Figure 3. — Photomicrograph showing the appearance of dust composed of cube (1% rotenone) in diatomaceous earth and applied with an open tube.

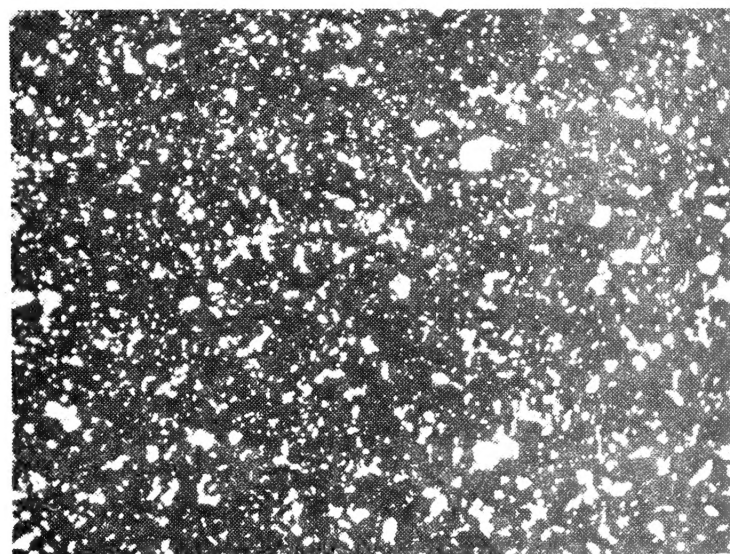


Figure 4. — Photomicrograph showing the appearance of a dust composed of cube (1% rotenone) in diatomaceous earth applied with a constricted tube.

